

KEYS TO THE FLORA OF FLORIDA -- 25, LEMNACEAE

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ABSTRACT

The Lemnaceae in Florida are represented by 4 genera: *Lemna*, with 5 species; *Spirodela*, with 2 species; *Wolffiella*, with 2 species; and *Wolffia*, with 3 species. Of these, 6 are non-native, and one is ranked as invasive. None is endemic. Three species of *Lemna* and one of *Wolffiella* are excluded. The use of *Spirodela oligorrhiza* is briefly justified. The segregate genus *Landoltia* is seen as unneeded. An amplified key is given to the Florida taxa. *Phytologia* 92(2): 241-248 (August 2, 2010).

KEY WORDS: *Lemna*, *Spirodela*, *Wolffiella*, *Wolffia*, Lemnaceae, Florida flora.

Species of the Lemnaceae, the duckweeds, are omnipresent members of the Florida wetlands flora. They float on or just below the surface of quiet waters, frequently as scattered plants, at times as exceedingly abundant masses. Often two or more species are found intermixed. And often -- perhaps because of their individually insignificant size, perhaps because of their reputed resistance to ready identification -- they are little noted and too little collected.

Early systematic knowledge of the Lemnaceae was brought together by Friedrich Hegelmaier of Germany, first by studies of the species of Brazil (1868), later by a world monograph of the family (1878, 1895). A more narrowly focused view of the American duckweeds was produced by Charles H. Thompson with his revision of the Lemnaceae of North American north of Mexico (Ann. Rep. Missouri Bot. Gard. 9: 1-21. 1898). Thompson recognized 7 species of *Lemna* (one consisting of 2 varieties), 2 species of *Spirodela* (one only as a footnote), 3 species of *Wolffiella*, and 3 species of *Wolffia*. With the exception of one species recognized later (*L. obscura*, raised from

varietal rank under *L. minor*), Thompson's study is quite similar to modern understanding of the genus. His detailed descriptions and his approximate ranges, as documented by citation of the many specimens examined, underlay all more recent work. Only a few changes in nomenclature, necessitated by examination of types then unavailable, has consequentially disturbed his presentation.

In the 1960s interest in the Lemnaceae was stimulated by Edwin H. Daubs (Ill. Biol Monogr. 34: 1-118. 1965) who attempted a revision of Hegelmaier's world monograph. [With uneven success; note a critical review: H. L. Clark & J. W. Thieret (Sida 2: 437-438. 1966).] For purposes of the present study, Daubs' strength lay in his personal knowledge of plants in the field, including Florida.

The 1960s also marked the rise in Europe of two centers of study of the Lemnaceae. In the Netherlands, C. den Hartog & F. van der Plas undertook a careful documentation of the classification of the family, with inclusion of new species and newly available flowering and fruiting structures, summarized by their comprehensive synopsis (Blumea 18: 355-368. 1970). And in Switzerland, Elias Landolt began his own exhaustive studies, including morphology, classification, distribution, even nutritional requirements, with a series of papers that perhaps equal if not surpass the level of understanding elsewhere attained of any plant family, culminating in his masterful two-volume "The Family of Lemnaceae" (1986).

Lack of early collection records for most Florida Lemnaceae gives uncertainty to the judgment of which species are native and which are introduced. Those considered here to be introduced are *Lemna minuta*, *Lemna minor*, *Spirodela oligorrhiza*, *Wolffiella oblonga*, *Wolffia brasiliensis*, and *Wolffia globosa*. Each has a limited Florida distribution or is disjunct from its range elsewhere. Of these, only *S. oligorrhiza* carries documentation as to its approximate date and possible mode of arrival. This species was first identified in the United States in Missouri where it was suspected to have been imported with goldfish (A. Saeger, Bull. Torrey Bot. Club 61: 233-236. 1934). The earliest Florida collection seen was in 1955. By 1961 it was found well established in 6 locations in peninsular Florida (E. H. Daubs, Rhodora 64: 83-85. 1962). Florida has an active tropical fish industry with

frequent imports, which may be the pathway by which these species have reached the state.

Even though previous studies of the Lemnaceae seem wholly comprehensive, a matter of nomenclature and one of classification requires attention. Landolt (1980, 1986, 2000) and others have treated *Spirodela oligorrhiza* under the name *S. punctata* (Meyer) Thompson. The basionym, *Lemna punctata* G. F. W. Meyer (1818), is of a spm. (GOET, now lost) from the Essequibo River, Guiana. Thompson (1898) equated (but did not neotype) Meyer's description of *L. punctata* with a collection labeled as from Tierra del Fuego (where no Lemnaceae are known to modern workers). This plant, now widely introduced in the American Southeast, is of Asian or Australian origin (Landolt, 1986), not South American. The possibility is remote that Meyer's plant from tropical Guiana could have been the same as the one (as Thompson believed) from frigid southern Patagonia. The Meyer specimen must have been of *S. intermedia* W. Koch (1932), the only one of these two species that is native and widespread in South America (incl. Guiana). With Thompson's error corrected, and with Meyer's *L. punctata* seen as conspecific with *S. intermedia*, the earliest name for the Asian introduction to southeastern North America is *Spirodela oligorrhiza* (Kurz) Hegelm. (basionym: *Lemna oligorrhiza* Kurz, 1867). This name was used by Daubs (Rhodora 64: 83-85. 1962) in the first report of its presence in Florida. This argument in greater detail, including apparent origin of the mislabeled Tierra del Fuego spm., is given elsewhere (Ward, in press). [As a corollary, the common South American plant must take on the name *S. punctata* (Meyer) Thompson, and *S. intermedia* W. Koch is reduced to synonymy.]

Spirodela oligorrhiza (or *S. punctata*, sensu Thompson) has recently been distinguished at generic level from other *Spirodela*, as *Landoltia punctata* (Meyer) Les & Crawford (Novon 9: 530-533. 1999). DNA data indeed appear to place *S. oligorrhiza* (with its several roots per plant) somewhat closer to *Lemna* (with its single root) than to *S. polyrrhiza* (also with several roots). Yet no harm will result if the morphologically similar (if possibly cladistically questionable) several-rooted species are kept together. If this species were confidently seen as closer to *Lemna* than to *Spirodela*, the proper action would have been to use the pre-existing name, *Lemna punctata* Meyer (1818),

rather than form a new single-species genus. It is noted that Elias Landolt, the dean of modern students of the Lemnaceae, never (in a paper wholly of his own writing) divided *Spirodela* (cf. Flora N. Amer. 22: 145. 2000).

The present study, limited to Florida plants, attempts to bring into sharper focus the 12 species of Lemnaceae found within the state. Most encouraging for the field botanist or environmentalist who has been tempted to pass over the duckweeds with a simple "*Lemna* sp." or an inaccurate "*Lemna minor*," their identification can be relatively straightforward. First, disregard those names whose presence in the state are reported in error. Second, dismiss as improbable the two species of *Lemna* and the one of *Wolffia* which, though reliably reported, are of great rarity. Third, recognize that the species of *Spirodela* and *Wolffiella*, two each, and the two remaining species of *Wolffia* are appreciably different from one another in gross form and can be readily distinguished. Thus remaining are 3 species of *Lemna* that themselves can be separated by careful inspection. Any red-purple coloration indicates *L. obscura*. One vein in frond suggests *L. valdiviana*. And 3 veins points to *L. aequinoctialis*.

LEMNACEAE Dumort.

Duckweeds¹

1. Plants with roots; with two lateral reproductive pouches.
2. Roots one per plant.
3. Upper surface of fronds flat, without papillae; fronds narrowly elliptic to ovate, very small (often <1.0 mm. long); veins one (or none apparent).
4. Fronds narrowly elliptic, somewhat asymmetric; plants usually in attached groups of 3-7. Floating or submersed aquatic herb. Quiet ponds, ditches. Throughout; frequent. Spring-summer. [*Lemna cyclostasa* (Ell.) Thompson]

***Lemna valdiviana* Phil.**

4. Fronds obovate, symmetric; plants usually separate or attached in pairs. Floating aquatic herb. Cool swamps. Central panhandle (Jackson, Leon counties); rare. Spring-summer. [*Lemna minima*, misapplied; *Lemna minuscula* Herter]

* **Lemna minuta** HBK.

3. Upper surface of fronds flat or convex, with papillae; fronds elliptic to obovate or orbicular, small (usually >1.5 mm. long); veins 3 (in some indistinct).

5. Sheath winged at base of root; fronds thin, translucent, with 3 distinct veins. Floating aquatic herb. Canals, ditches, quiet ponds. Throughout; common, at times locally profuse. Spring-summer. [*Lemna trinervis* (Austin) Small]

Lemna aequinoctialis Welw.

5. Sheath cylindrical at base of root, without wings; fronds opaque, with 3 sometimes indistinct veins, shiny on upper surface.

6. Lower surface of fronds dark red-purple, convex; upper surface with a single evident papilla near apex. Floating aquatic herb. Warm water of ditches, shallow ponds. Throughout; common, often exceedingly abundant in nutrient-rich cattle ponds. Summer-fall. [*Lemna gibba*, misapplied; *Lemna minor* var. *obscura* Austin]

SOUTHERN DUCKWEED **Lemna obscura** (Austin) Daubs

6. Lower surface of fronds green to faintly red-purple, flat to convex; upper surface with several indistinct papillae in line near apex. Floating aquatic herb. Ditches. North Florida (Columbia Co.); rare. Summer. [*Lemna minima* Thuill. ex Beauv.]

* **Lemna minor** L.

2. Roots two or more per plant.

8. Plants with 5-10 roots; fronds 2.5-8.0 mm. wide, with 5-15 prominent veins. Floating aquatic herb. Cypress swamps, shaded ponds, spring runs. Throughout; common. Spring-summer.

GREATER DUCKWEED ***Spirodela polyrrhiza*** (L.) Schleid.

8. Plants with 2-5 roots; fronds 1.5-3.0 mm. wide, with 3-5 obscure veins. Floating aquatic herb. Ditches, stream margins, swamps. Throughout; very common, often profusely covering water surface. Spring-summer. Invasive (first record: Dunedin, Pinellas Co., 1955). [*Spirodela punctata*, misapplied; *Landoltia punctata*, misapplied].

LESSER GREATER DUCKWEED.

* ***Spirodela oligorrhiza*** (Kurz) Hegelm.

1. Plants without roots; with one basal reproductive pouch.

9. Fronds flat, thin, appearing two-dimensional, >4 times longer than wide.

10. Fronds 0.4-0.7 mm. wide, >9 times as long as wide, scimitar-shaped. Submersed aquatic herb. Floating just below surface of quiet waters. Throughout; frequent. Spring-summer-fall. [*Wolffiella floridana* (J. D. Sm.) Thompson]

Wolffiella gladiata (Hegelm.) Hegelm.

10. Fronds 0.5-1.5 mm. wide, <8 times as long as wide; tapered-oblong. Floating or submersed aquatic herb. Swamps, canals. Peninsula (Collier to Alachua counties), scattered to central panhandle (Wakulla Co.); infrequent. Spring-summer-fall.

* ***Wolffiella oblonga*** (Phil.) Hegelm.

9. Fronds ellipsoidal, strongly biconvex, three-dimensional, <2 times as long as wide.

11. Frond with sharply defined upper and lower surfaces, the upper supporting a blunt conical mound arising from flat surface, the lower strongly convex (plants thus \pm boat-shaped); brown pigment cells apparent within tissue. Minute floating aquatic herb. Ditches, ponds. Across panhandle (Escambia, Jackson, Leon counties), north Florida; infrequent. Spring-summer. Fronds appear to have cuticularized upper surface, thus float dry. [*Bruneria punctata* (Griseb.) Nieuwl.; *Wolffia papulifera* Thompson; *Wolffia punctata* Griseb.]

* **Wolffia brasiliensis** Wedd.

11. Frond with confluent upper and lower surfaces, hemispherical (plants prolate-spheroidal or football-shaped); dark pigment cells absent.

12. Fronds subspheroidal, 1.0-1.3 times as long as broad, >0.4 mm. wide. Minute floating or submersed aquatic herb. Ponds, ditches, spring-fed streams. Throughout; frequent (infreq. in south peninsula). Spring-summer. Fronds not cuticularized, thus float below meniscus. [*Bruneria columbiana* (Karst.) Nieuwl.]

WATERMEAL

Wolffia columbiana Karst.

12. Fronds ellipsoidal, 1.3-2.0 times as long as broad, <0.5 mm. wide. Minute floating aquatic herb. Ditches. West-central peninsula (Pinellas Co.); rare. Summer.

* **Wolffia globosa** (Roxb.) Hartog & Plas

Excluded names:

Lemna gibba L.

Reported for southeast U.S. (H. L. Clark, in Godfrey & Wooten, 1979), but restricted to areas westward (Landolt, Flora N. Amer. 22:147. 2000). Many plants so identified are of *L. obscura*.

Lemna perpusilla Torr.

Northern. Reported for Florida (Small, 1933; Godfrey & Wooten, 1979), apparently by confusion with *L. aequinoctialis*.

Lemna trisulca L. Star Duckweed

Northern. Reported for Florida (Daubs 1962, 1965). Not known south of Virginia (Landolt, 2000).

Wolffiella lingulata (Hegelm.) Hegelm.

Reported as "rare, Glades Co." (Landolt, 1980). Not found again. Best seen as an ephemeral introduction.

¹ The "amplified key" format employed here is designed to present in compact form the basic morphological framework of a conventional dichotomous key, as well as data on habitat, range, and frequency. This paper is a continuation of a series begun in the 1970s (vide *Phytologia* 35: 404-413. 1977). The authors are grateful to Keith A. Bradley, Inst. Regional Conserv., Miami, and James R. Burkhalter, Pensacola, for field observations; to Elias Landolt, Geobotanisches Institut ETH, Zurich, for generously sharing his maps of Florida distribution; to Theodore R. Dudley, U.S. Department of Agriculture, Beltsville, for insight as to the present flora of Tierra del Fuego (and lack therein of all Lemnaceae); and to Richard H. Eyde, Smithsonian Institution, Washington, for detailed information regarding botanical aspects of the Great Exploring Expedition to southernmost South America and the islands of the western Pacific.